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# Oklahoma Agricultural Soil Test Summary 1994-1999

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An accurate evaluation of soil fertility levels for an individual county or a whole state is necessary for estimating nutrient needs, tracking changes in soil pH and nutrient levels, and serving as a guideline for manure nutrient redistribution. The Oklahoma Cooperative Extension Service's Soil, Water, and Forage Analytical Laboratory analyzes soil samples and archives testing results for 76 of 77 Oklahoma counties. The soil fertility summary of 65,656 cropland samples tested from 1994-1999 is presented in Table 1 and Table 2. All of the identifiable lawn, garden, and research samples were excluded in the summary since most of them do not represent the real situation in agricultural fields. Soil samples were analyzed for pH, buffer index (BI) if pH was less than 6.5, $NO_3$-N (lbs/acre), soil test phosphorus (STP) index, and soil test potassium (STK) index. Medians are given along with the average because most of the data do not have normal distributions, and sometimes averages give a false impression on where the center of the distribution lies for non-normal distributions.

This summary may provide a valuable index of the soil fertility status of Oklahoma farmland, but soil samples need to be collected and analyzed for an individual field to better manage soil fertility and to correct the soil acidity problem. Similar summaries for each county are also available. The county data may be used to better distribute nutrients in animal manure to where they are needed. To request a copy for a specific county, please contact the author at 405-744-9566 or hailin.zhang.okstate.edu.

**Table 2. Median, average, and ranges of test results for all agricultural soil samples.**

| | *pH* | *$NO_3$-N (lbs/a)* | *STP Index* | *STK Index* |
|---|---|---|---|---|
| Median | 5.9 | 12 | 57 | 342 |
| Average | 6.1 | 21 | 100 | 399 |
| Maximum | 10.8 | 988 | 1990 | 1996 |
| Minimum | 3.6 | 1.0 | 1.0 | 11 |

**Table 1. Distribution of soil pH, $NO_3$-N (lb/ac), Soil Test P Index, and Soil Test K Index tested from 1994 to 1999.**

| | | | | | | |
|---|---|---|---|---|---|---|
| Soil pH | <5.0 | 5.0-5.4 | 5.5-5.9 | 6.0-6.4 | 6.5-7.4 | >7.4 |
| Count | 5881 | 12727 | 14294 | 10368 | 14574 | 7521 |
| Percent | 9.0% | 19.5% | 21.9% | 15.9% | 22.3% | 11.5% |
| $NO_3$-N (lbs/a) | 0-9 | 10-19 | 20-39 | 40-59 | 60-79 | >79 |
| Count | 27066 | 17265 | 13188 | 4203 | 1755 | 2179 |
| Percent | 41.2% | 26.3% | 20.1% | 6.4% | 2.7% | 3.3% |
| STP Index | 0-19 | 20-39 | 40-65 | 66-119 | 120-299 | >299 |
| Count | 5904 | 14079 | 17672 | 16167 | 7706 | 4121 |
| Percent | 9.0% | 21.4% | 26.9% | 24.6% | 11.7% | 6.3% |
| STK Index | 0-74 | 75-124 | 125-199 | 200-249 | 250-349 | >350 |
| Count | 342 | 3353 | 10069 | 7075 | 12618 | 32056 |
| Percent | 0.5% | 5.1% | 15.4% | 10.8% | 19.3% | 48.9% |

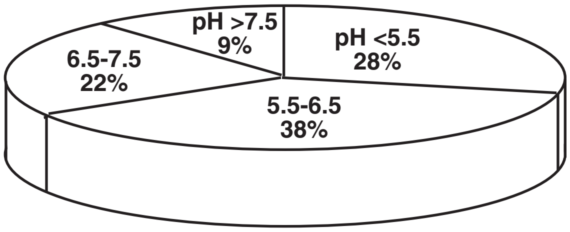


**Figure 1. Soil pH distribution of soils tested between 1994 and 1999.**

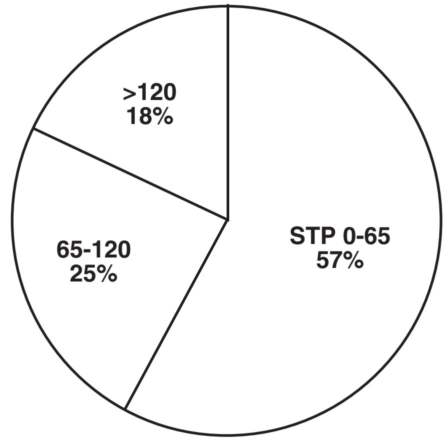


**Figure 2. Distribution of soil test P index in Oklahoma soils tested between 1994 and 1999.**

## Soil pH and Lime Requirement

The pH of Oklahoma soils tends to be low with a median of 5.9. Soil pH of all soils is divided into four groups and shown in Fig. 1. Twenty-eight percent of the 65,656 samples had a pH less than 5.5 and indicated a potential production loss due to soil acidity. Low soil pH has become a crop production problem of increasing concern in many parts of Oklahoma, especially in the central wheat-growing region where 39 percent of the fields had a pH less than 5.5. Strong soil acidity not only lowers the availability of phosphorus but also increases the level of toxic elements present such as aluminum and manganese. Banding phosphate fertilizer and using aluminum tolerant wheat varieties have shown some benefits on acid soils, but eventually lime must be used to neutralize the acidity and sustain crop production.

## Soil Nitrate-Nitrogen ($NO_3$-N)

The distribution of $NO_3$-N of all the surface soils is shown in Table 1. The majority of the surface soil samples had less than 20 pound residual $NO_3$-N per acre (median 12 lbs./acre). Only 12.4 percent of the fields sampled had nitrate-N greater than 40 lbs./acre, and 3.3 percent greater than 80 lbs./acre. This indicates most farmers would need to apply N fertilizer for crop production based on surface soil tests alone. However, subsoil samples (6 and 24 inches) could contain significant amounts of nitrate nitrogen. Deep-rooted crops, such as winter wheat, can penetrate and utilize the nitrate from the subsoil during growth. Since very few farmers submitted subsoil samples, subsoil nitrate results were not included in the calculations. However, results from the 1996 free wheat soil program clearly demonstrated the importance of taking subsoil samples for estimating residual nitrogen in the subsoil. Farmers can save on their fertilizer cost and minimize nitrate leaching if they take available N in the subsoil into consideration and follow soil test recommendations.

## Soil Test P Index

The phosphorus soil test estimates the availability of soil phosphorus during the whole growing season. The Mehlich III extraction method has been used in Oklahoma and many other central and eastern states for plant available P and K analysis. The estimated availability is reported as an index and percent sufficiency in the soil (See PSS-2225 for details). Phosphorus fertilizer needs to be added if the soil test P index is less than 65 (100 percent sufficient). The available P status is graphed in Figure 2. About 57 percent of the soil samples had index values less than 65, or less than 100 percent sufficiency; therefore, those soils need various amounts of commercial P to achieve the potential crop yields. A quarter of the samples had a STP index between 65 and 120. In this range, some crops may benefit from additional P fertilizer but it may not be cost effective. Only 18 percent of the fields had STP over 120, although some parts of the state had a much higher percentages of this category due to heavy application of animal manure. Knowing where P is deficient will help any manure marketing effort to redistribute nutrients and reduce the impact to water quality.

## Soil Test K Index

Most of Oklahoma soils are high in potassium, probably, attributed to the parent materials and low rainfall under which our soils are developed. Data in Figure 3 confirms this tendency. Only 34 percent of the fields had a STK index less than 250 or sufficiency less than 100 percent, for all crops except for alfalfa, which would need additional K to meet crop requirements. The 100 percent sufficiency STK for alfalfa is 350.

## Median STP and Soil pH in Counties

The median soil tests P index and soil pH are presented on Oklahoma County maps (Figures 4 and 5). In general, soil pH are neutral to calcareous in the west and southwest part of the state, but acidic in the east and north central Oklahoma. There is no obvious pattern of STP distribution. Three counties had STP over 100 for different reasons. Oklahoma County may have many lawn and garden soils mislabeled as agricultural samples since most lawn and garden soils are high in STP. High STP in Adair and Delaware Counties may be due to the fact that most soil samples were collected from manured fields.

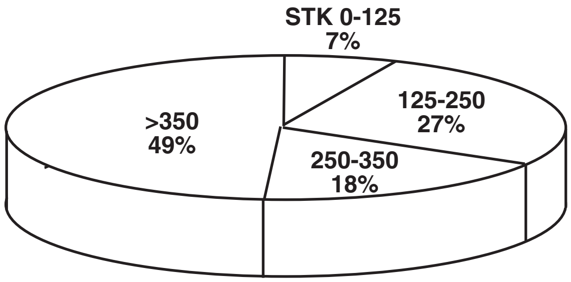


Figure 3. Distribution of soil test K index in Oklahoma soils tested between 1994 and 1999.

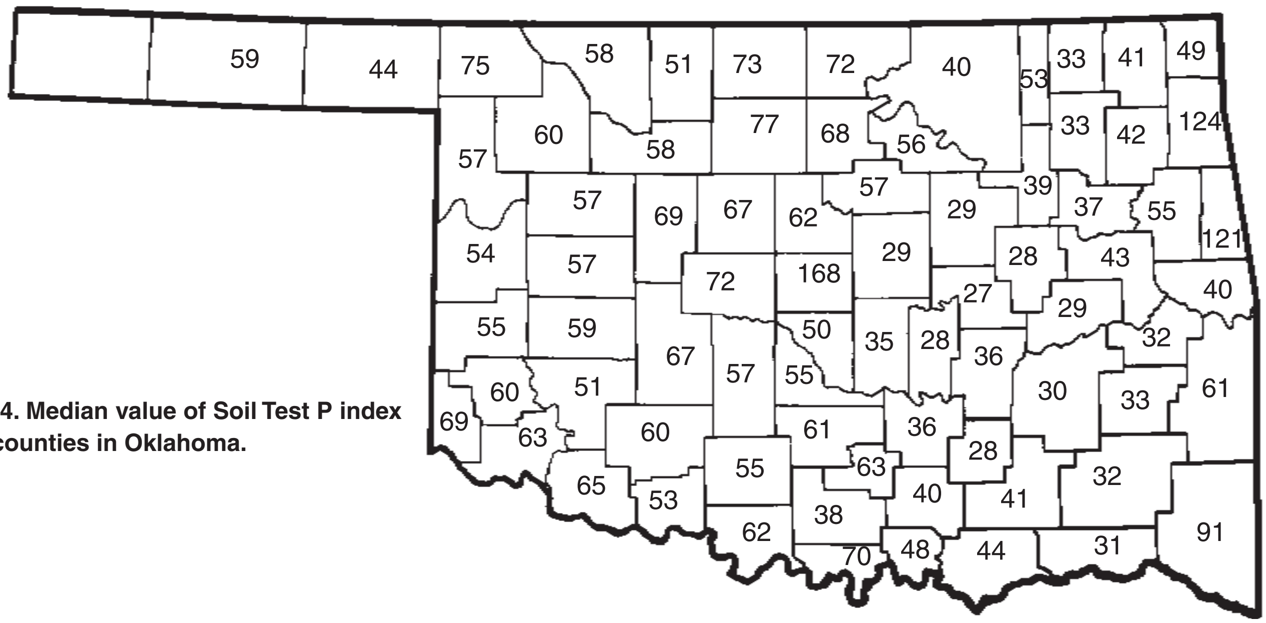


Figure 4. Median value of Soil Test P index for 76 counties in Oklahoma.

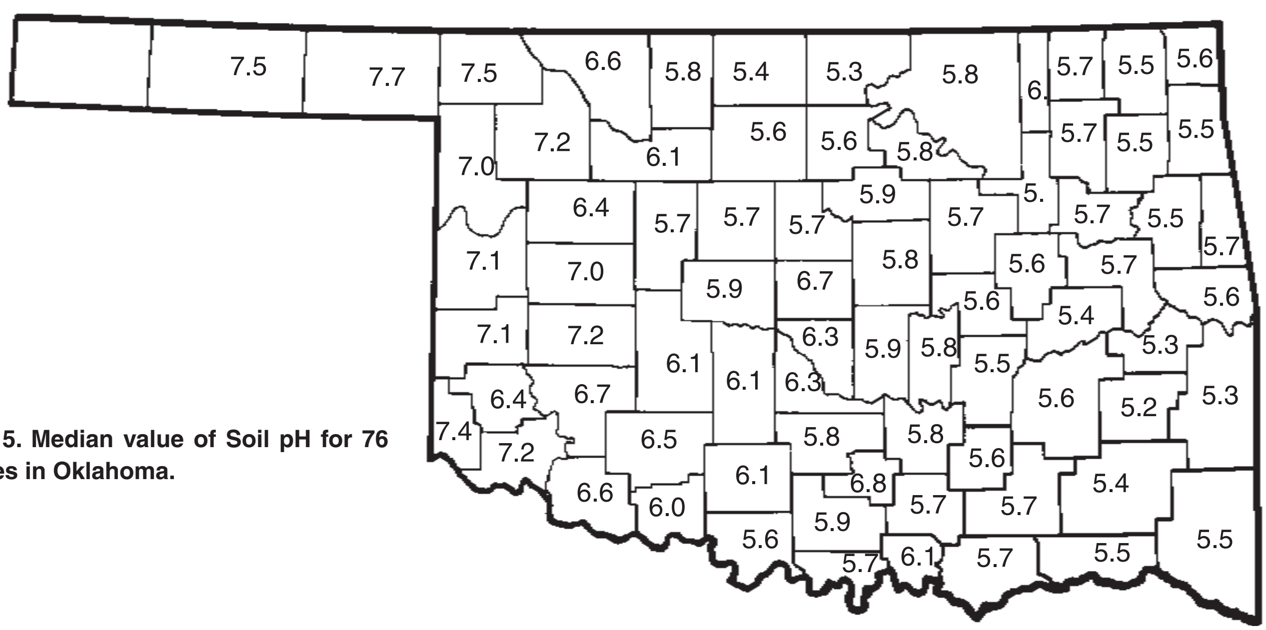


Figure 5. Median value of Soil pH for 76 counties in Oklahoma.

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